

The Alchemist

(AKA First Price Bernanke)

pooyaj@

[go/bernanke-for-1p](#)

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(THIS IS THE INTERNAL TO GTRADE DOC NOT TO BE SHARED!)

Summary

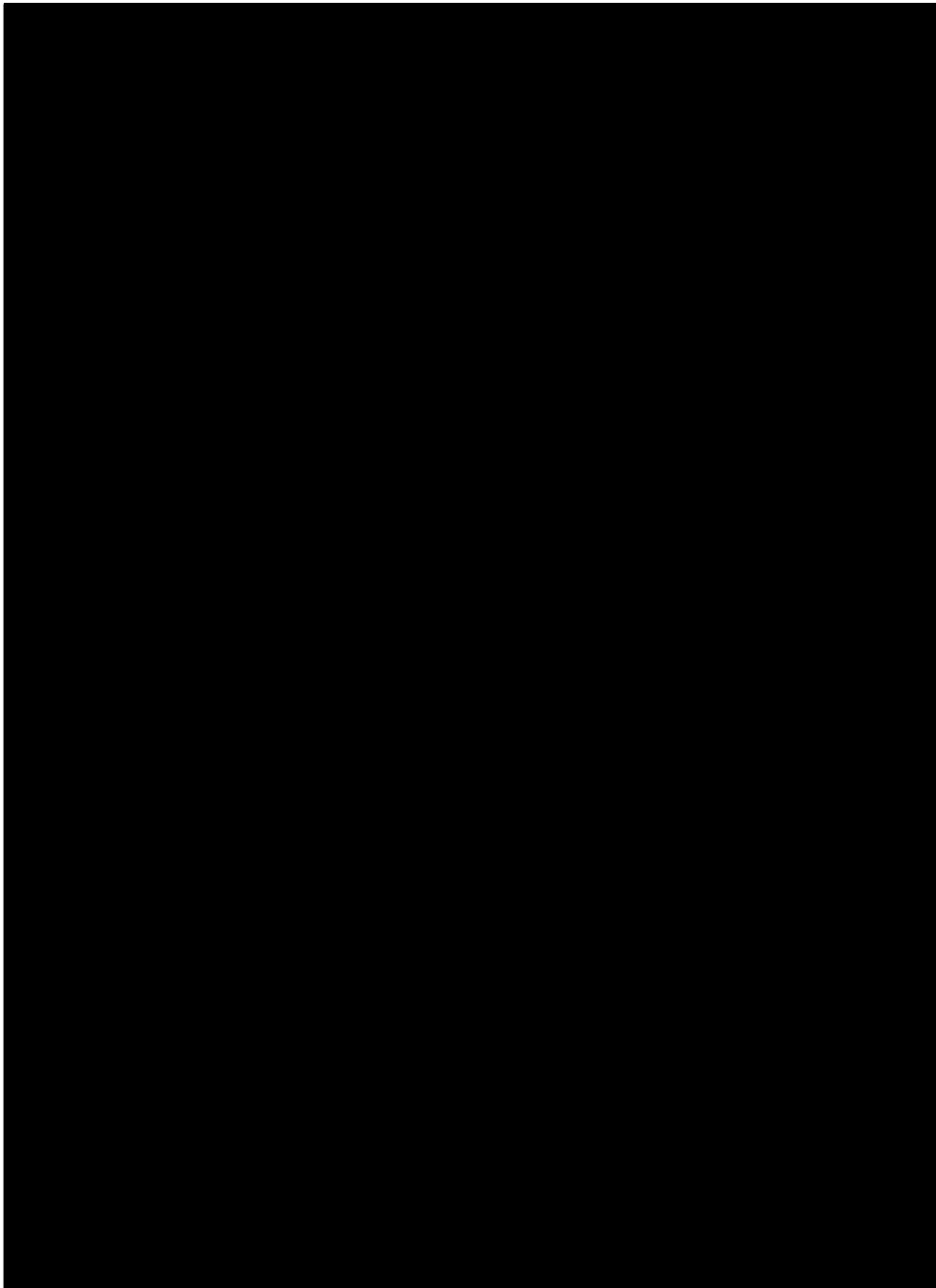
- Alchemist is a mechanism that:
 - Is truthful: no advertiser has an incentive to misreport her value
 - Is individually rational: no advertiser pays more than its declared value
 - Submits first price bids to publishers (while being truthful from buyer's perspective)
 - Satisfies margin constraint: it allows revenue over payout to be adjusted per publisher
 - Maximizes welfare for its spending: no mechanism can pay the same/lower amount of money to publishers and achieve a higher welfare
 - Has minimal processing overhead in serving
 - Allows improvements on the basic first price bid optimization models to improve its results without needing any changes
 - Provides a robust framework: it allows maximizing profit and potentially adding additional constraints (if necessary) on top of having all the other properties.
- Status: Implemented ([design doc](#))

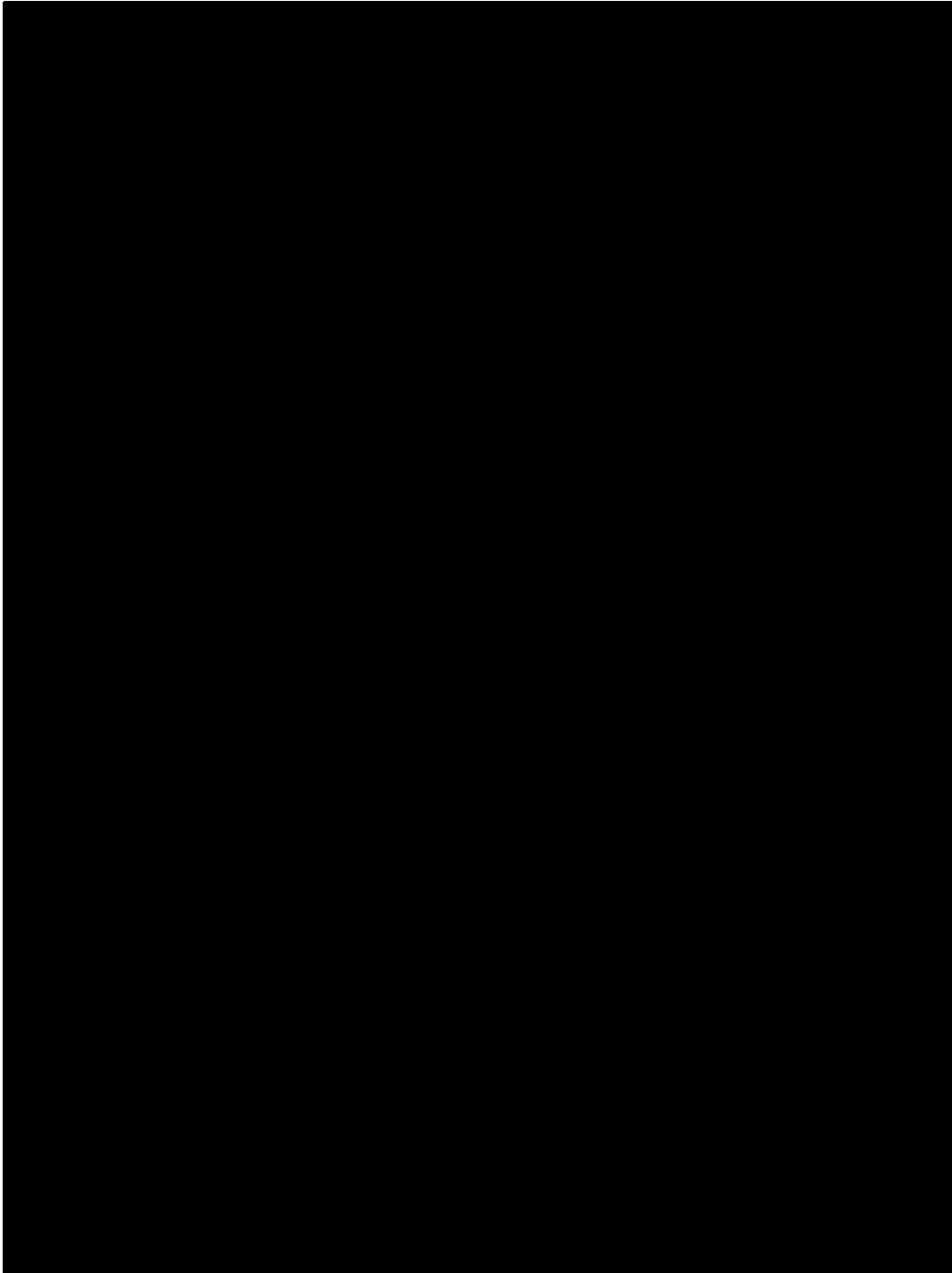
Problem

Switching to First Price Auctions (FPA) makes GDN's first price bid optimization (for the winner of Adwords Mini Auctions) a unique problem in many ways: Because of the buy-side infrastructure (like HDML) which was designed for bidding in a Second Price Auctions (SPA), we want to keep the mechanism truthful and individually rational from the buy-side's perspective and at the same time bid in sell-side's FPA. Furthermore, for each sell-side's publisher, we want to hit a specific (15%) margin. In this document we propose Alchemist: a simple mechanism (and a robust framework) that satisfies all these constraints while maximizing welfare and profit.

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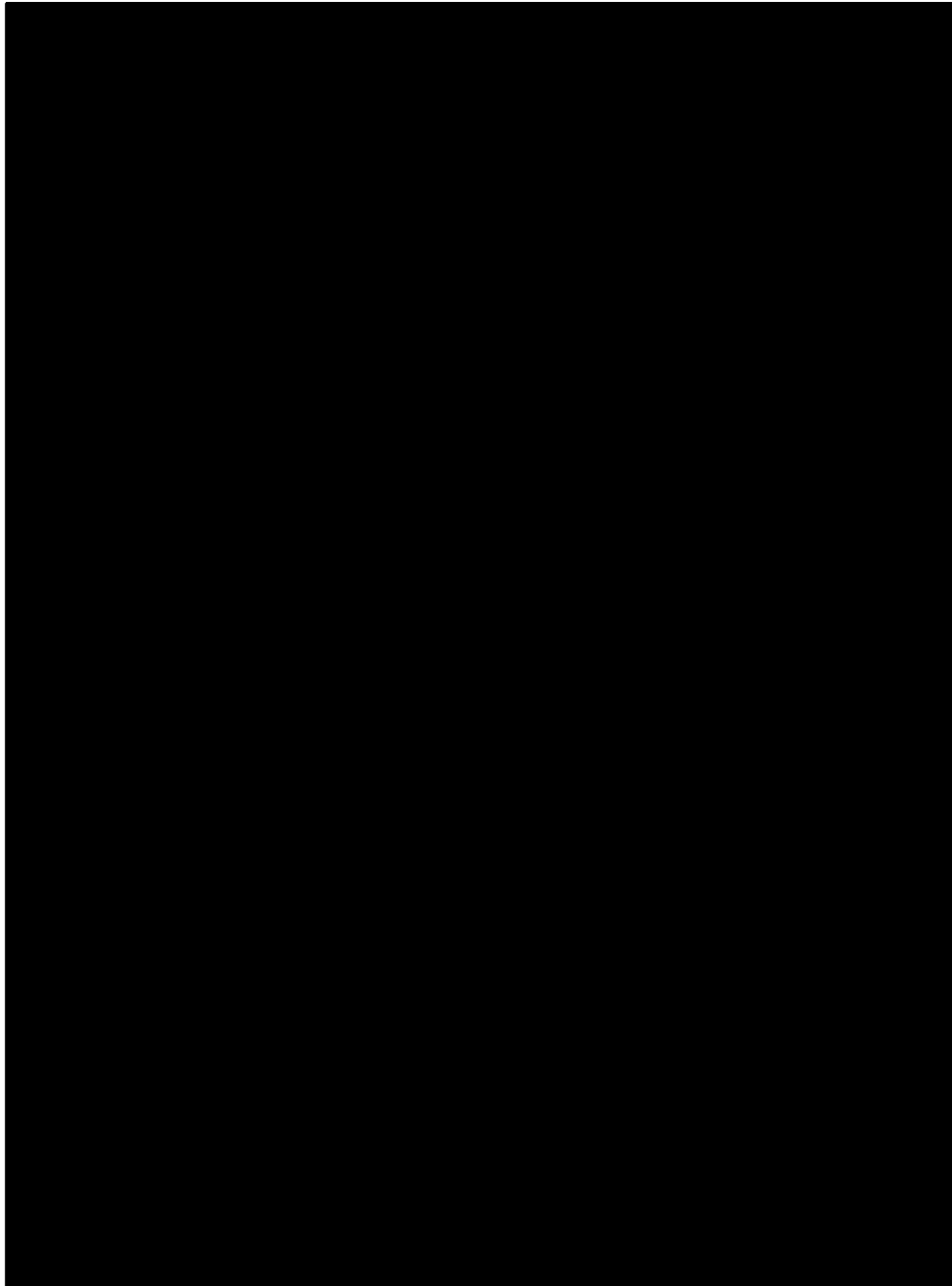
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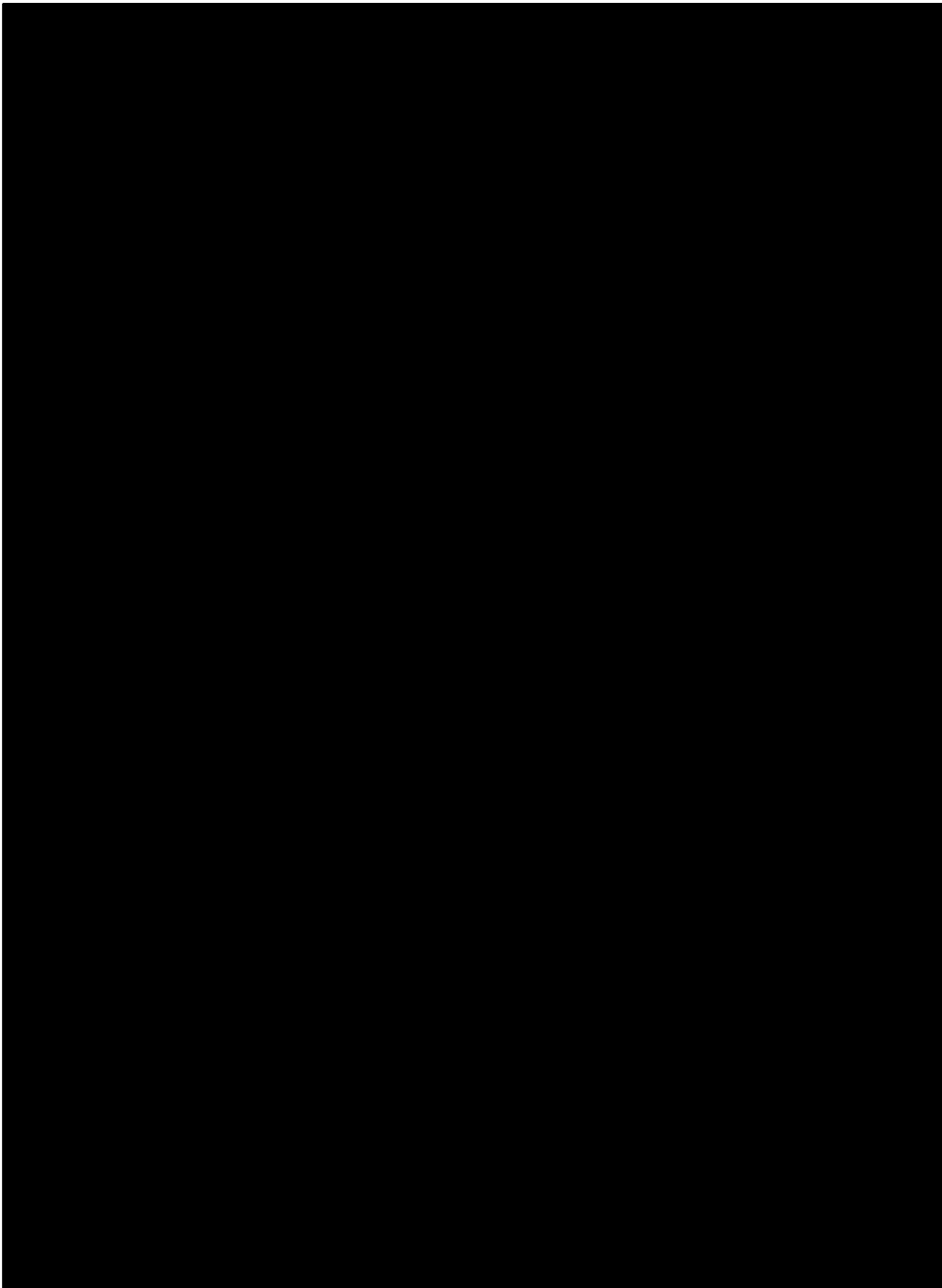
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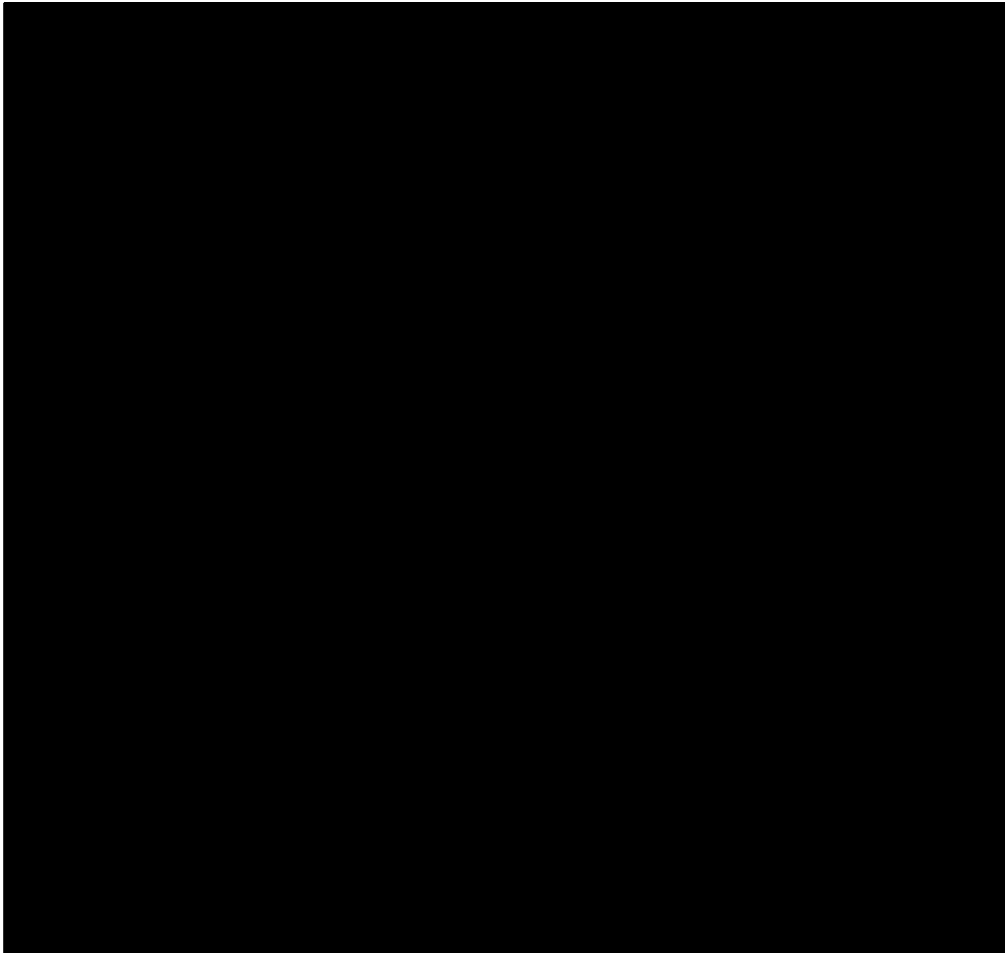
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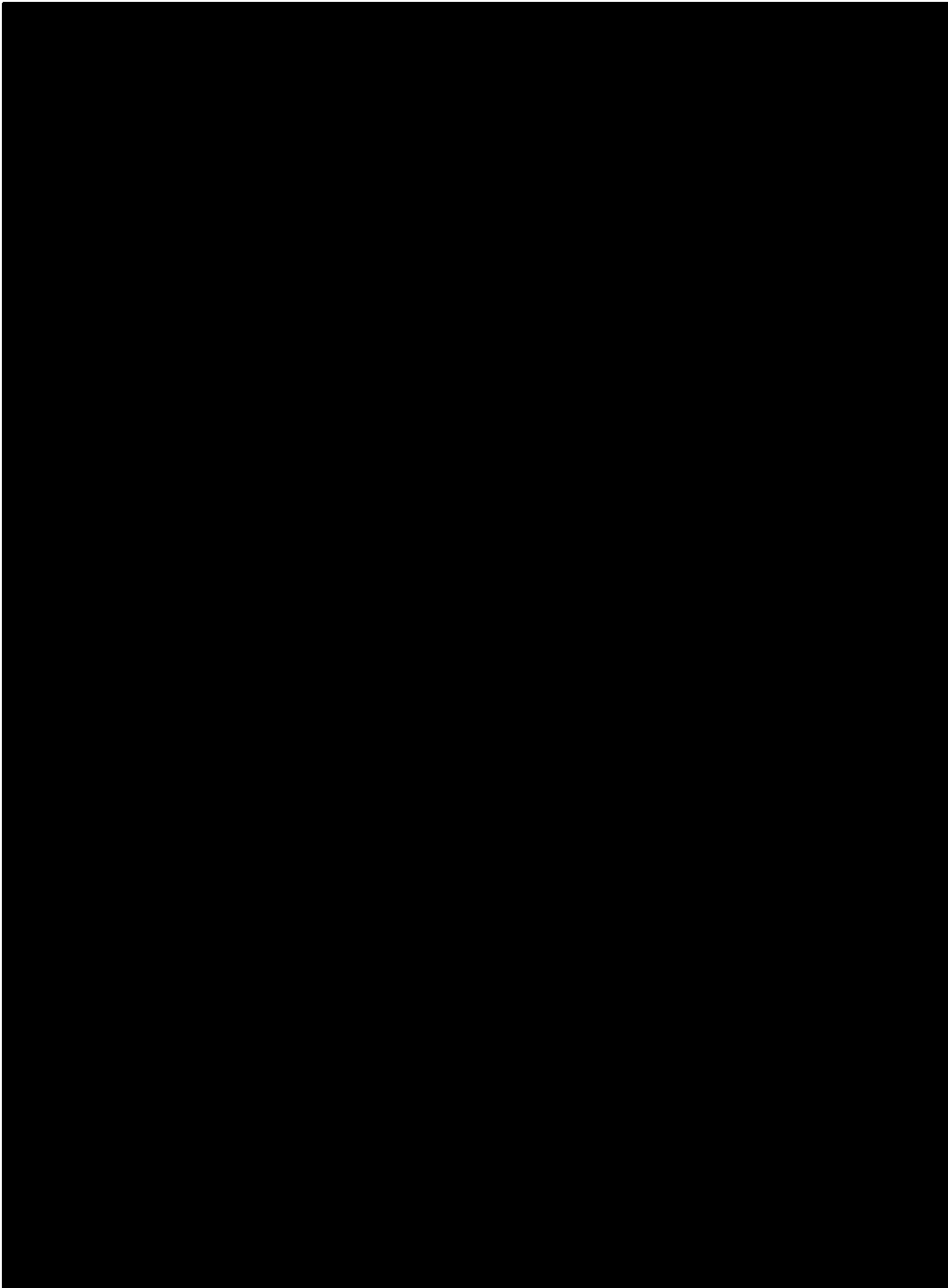


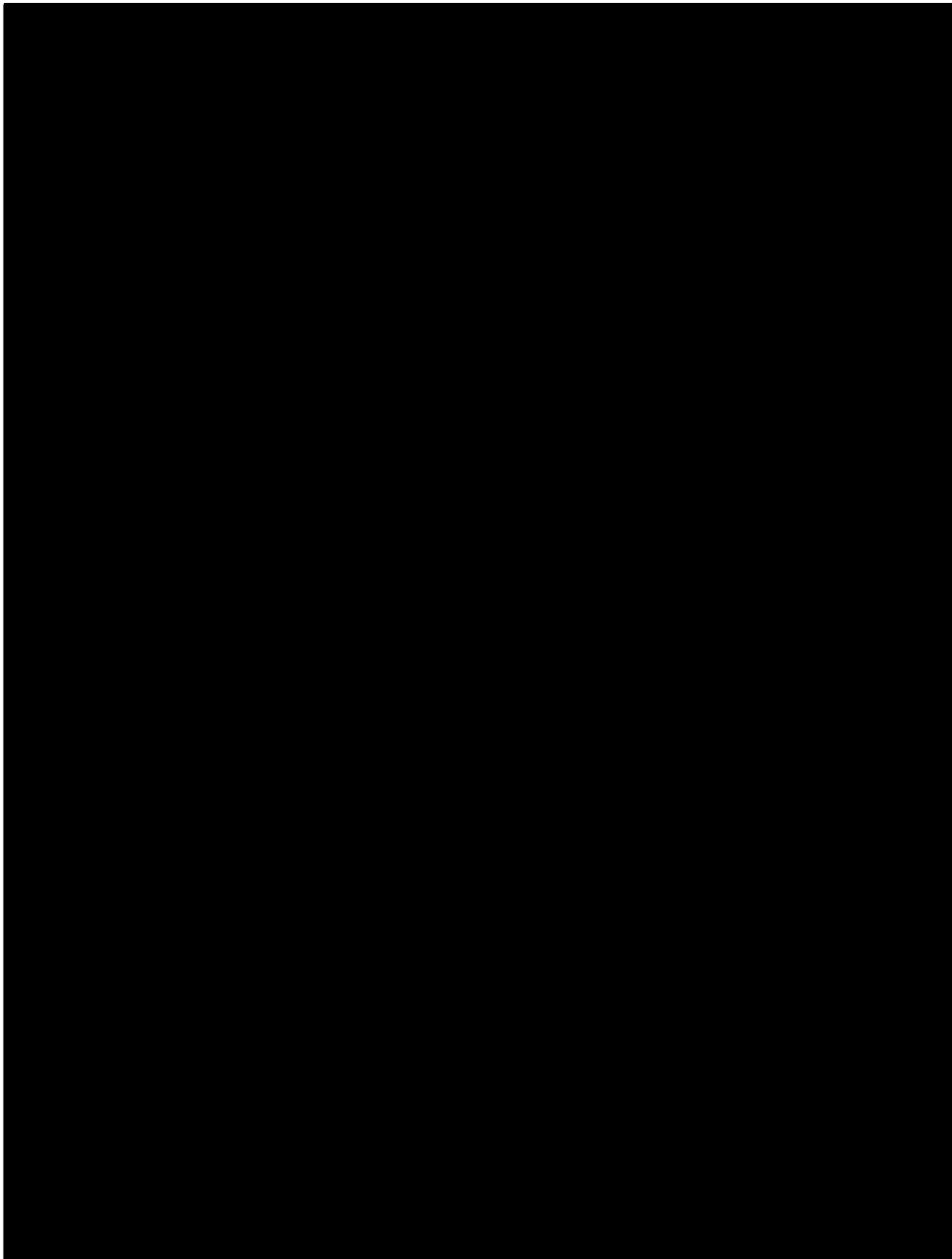
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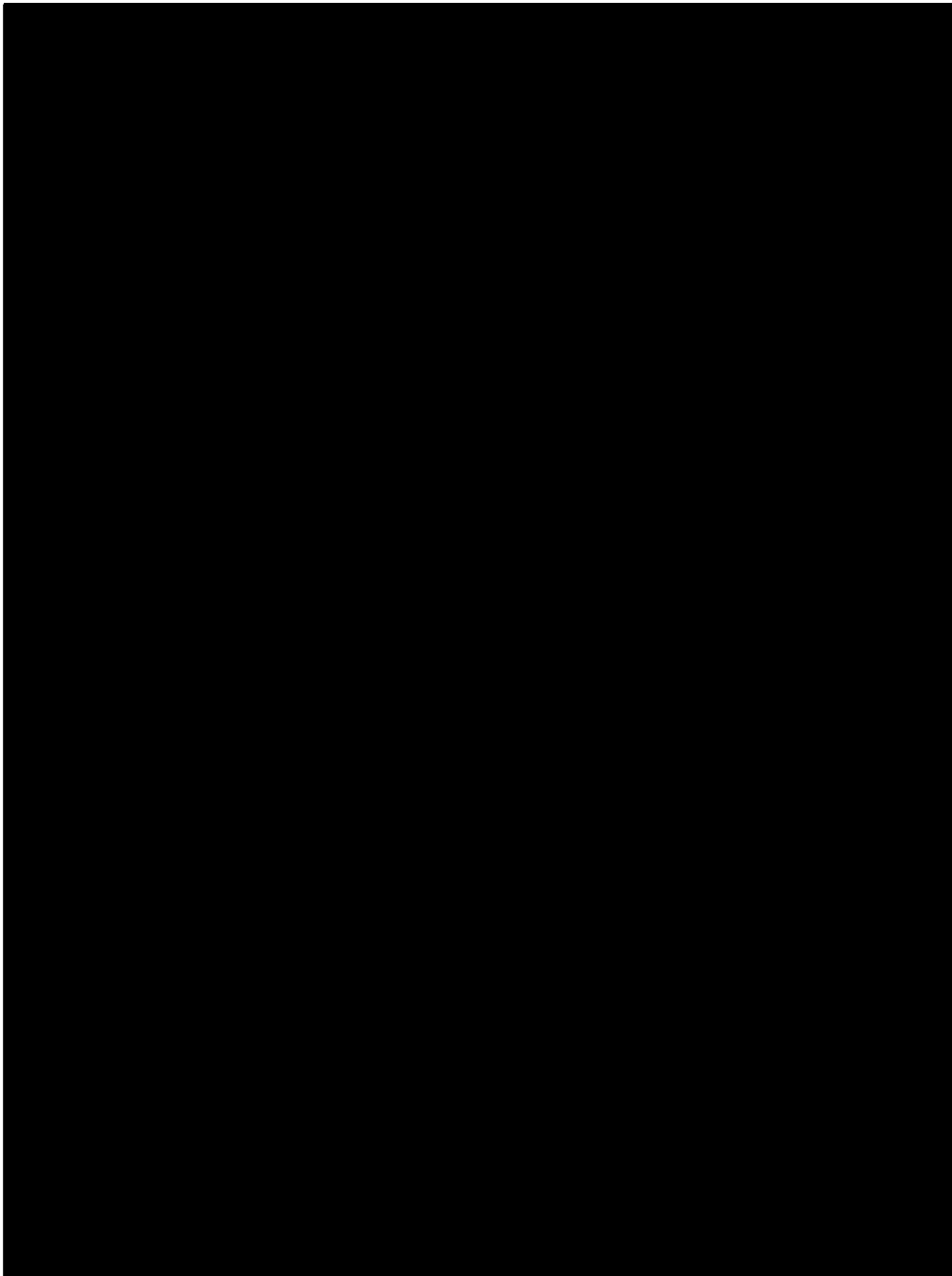


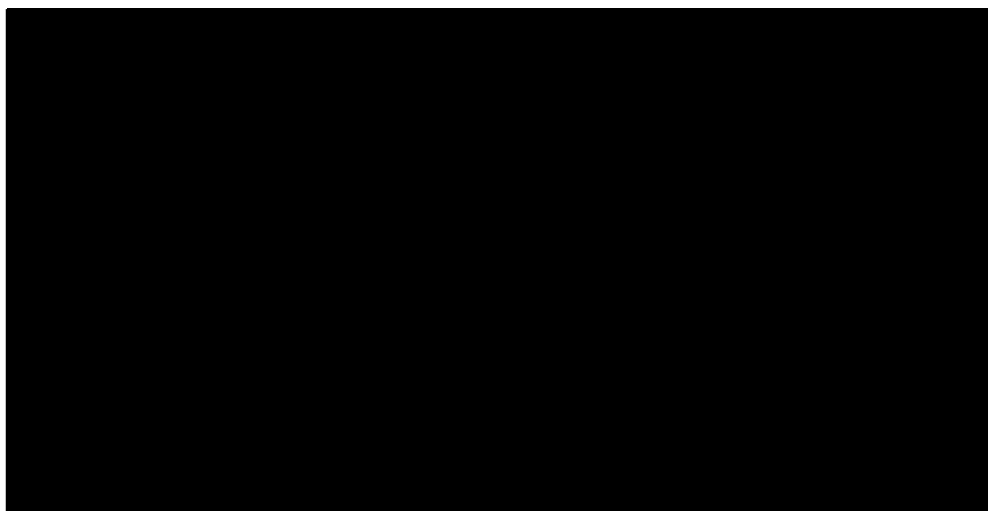




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Results

Alchemist vs Log-linear Bidding Strategy

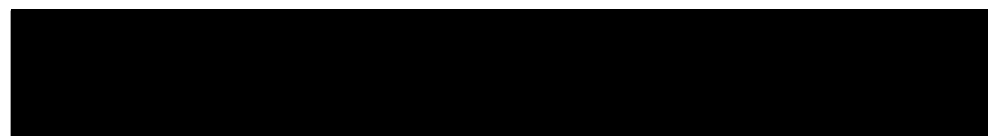


Table 1

ρ	Alchemist				Log-linear			
	Rev.	Pay.	Welf.	Win.C.	Rev.	Pay.	Welf.	Win.C.
0	84024.43	71420.59	219911.22	27581	78692.17	66881.09	213679.06	27619
0.3	92165.77	78341.92	197572.14	26733	94917.59	80671.56	199389.08	25985
0.6	96119.94	81701.15	165876.38	25078	53085.19	45124.63	103007.92	25032
0.9	86405.12	73444.94	110495.18	19707	73279.78	62291.89	95081.37	23973

Table 2 (Alchemist vs Log-linear)

ρ	Profit Inc.	Welfare Inc.	Surplus Inc.
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0	2.91%	6.71%	1.01%
0.3	-0.91%	-2.96%	1.00%
0.6	61.03%	81.12%	1.45%
0.9	16.21%	17.94%	1.12%



Table 3

ρ	Alchemist				Log-linear			
	Rev.	Pay.	Welf.	Win.C.	Rev.	Pay.	Welf.	Win.C.
0	79202.03	67322.04	199128.12	23375	77080.59	65517.47	196013.01	23152
0.3	84538.06	71858.15	173694.78	22036	32263.07	27422.13	85385.64	17626
0.6	82923.36	70485.58	137620.88	19370	9.09	7.53	28.02	57
0.9	52661.19	44761.64	65458.11	10685	8737.86	7427.57	11318.34	6926

TableAlchemist vs Log-li 4 (Alchemist vs Log-linear)

ρ	Profit Inc.	Welfare Inc.	Surplus Inc.
0	1.58%	2.74%	1.01%
0.3	103.42%	161.93%	1.75%
0.6	490955.71%	796156.07%	3276.59%
0.9	478.33%	502.88%	5.31%



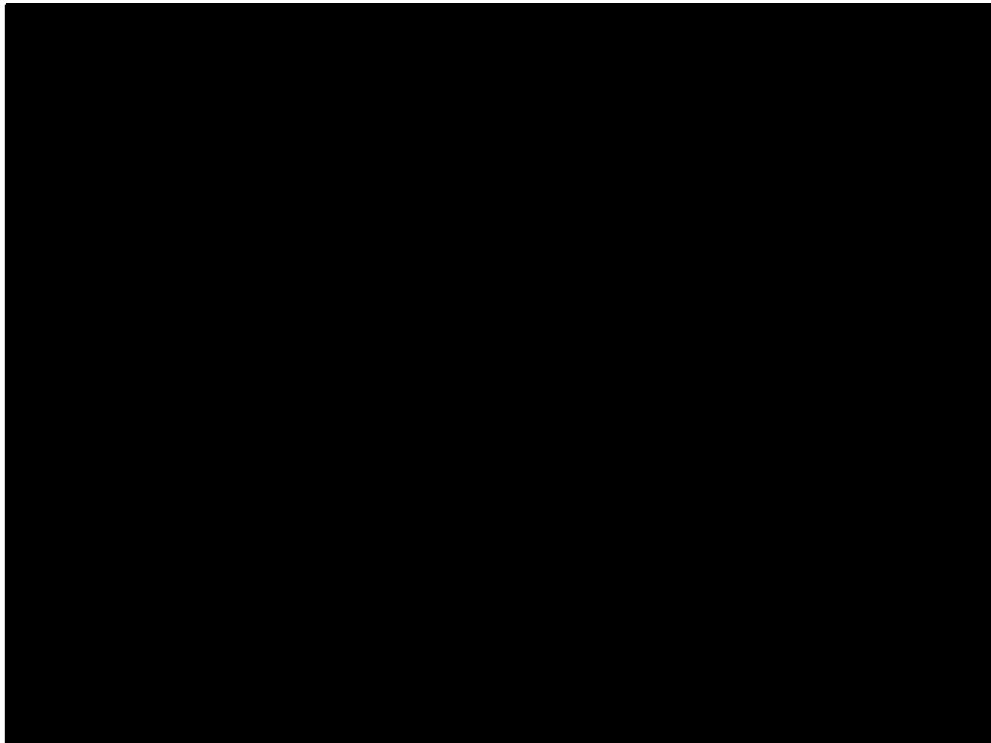
Table 5

ρ	Alchemist	Log-linear
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	Rev.	Pay.	Welf.	Win.C.	Rev.	Pay.	Welf.	Win.C.
0	103499.49	87973.95	288082.27	31121	97796.69	83132.31	281766.26	31233
0.3	117335.02	99734.30	264463.43	31257	24938.63	21195.73	86647.58	18225
0.6	133740.33	113678.47	241619.36	31538	121582.61	103340.44	227951.73	34473
0.9	155502.80	132176.48	206908.97	31604	122777.19	104364.10	167582.09	36821

Table 6 (Alchemist vs Log-linear)

ρ	Profit Inc.	Welfare Inc.	Surplus Inc.
0	2.24%	5.87%	1.00%
0.3	205.21%	370.24%	2.51%
0.6	5.99%	9.97%	1.02%
0.9	23.46%	26.68%	1.18%



[REDACTED]

Table 7

ρ	0.0	0.3	0.6	0.9
α_s	0.85128	0.89854	0.91643	0.89606
Alchemist's Profit	12603.83	13823.85	14418.78	12960.17
Opt's Profit	95.81	5500.24	8026.14	6478.37
Surplus dec.	0.828%	0.574%	0.786%	3.605%

[REDACTED]

Table 8

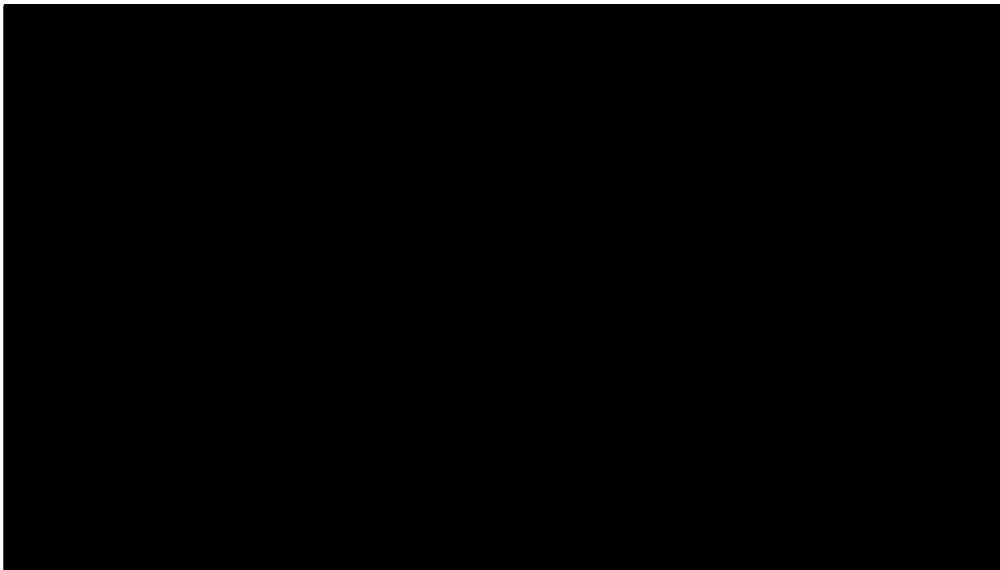
ρ	0.0	0.3	0.6	0.9
α_s	0.84886	0.89131	0.90547	0.87674
Alchemist's Profit	11879.98	12679.91	12437.7739448	7899.55
Opt's Profit	-493.76	4662.13	6032.04	2476.06
Surplus dec.	0.640%	0.980%	1.070%	4.689%

[REDACTED]

Table 9

ρ	0.0	0.3	0.6	0.9
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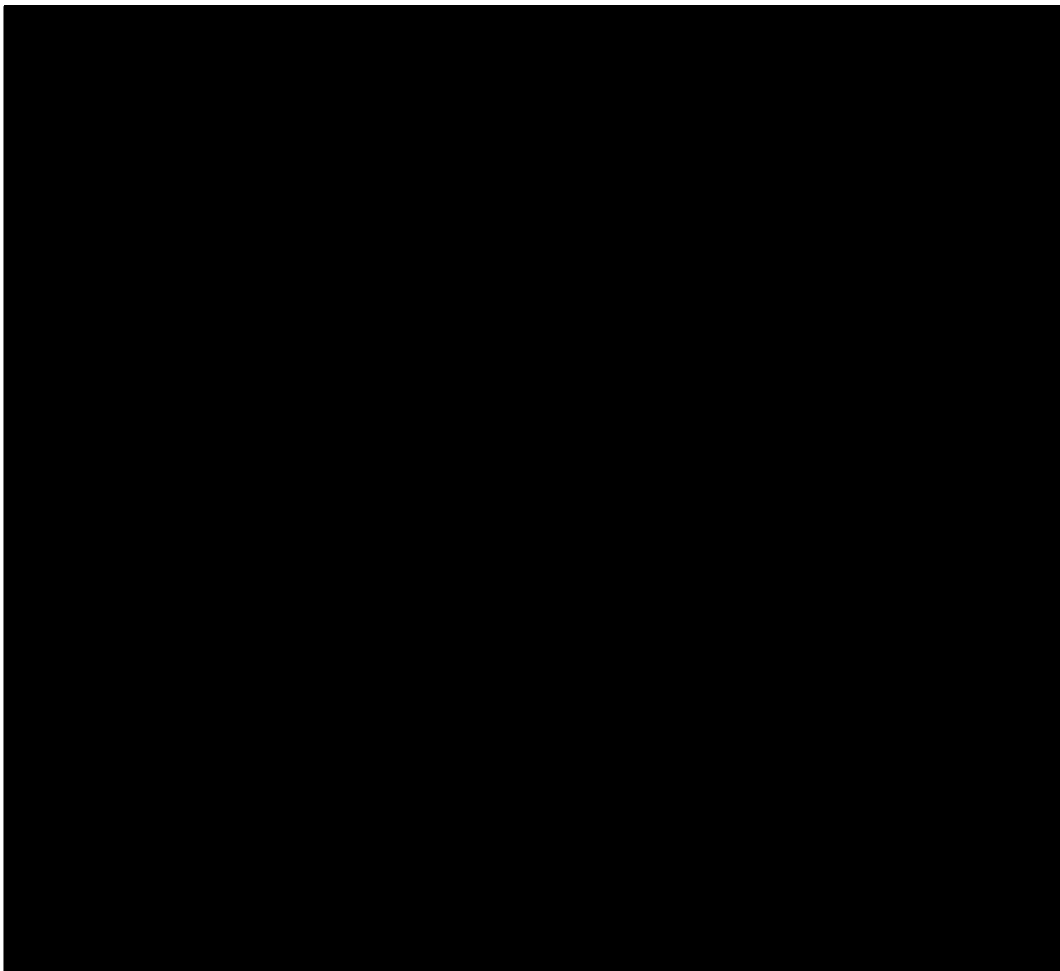
α_s	0.84459	0.89960	0.92800	0.91901
Alchemist's Profit	15525.53	17600.72	20061.85	23326.31
Opt's Profit	-20.61	7121.62	11990.83	14776.07
Surplus dec.	1.099%	0.444%	0.017%	1.338%



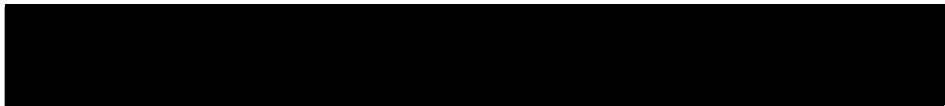


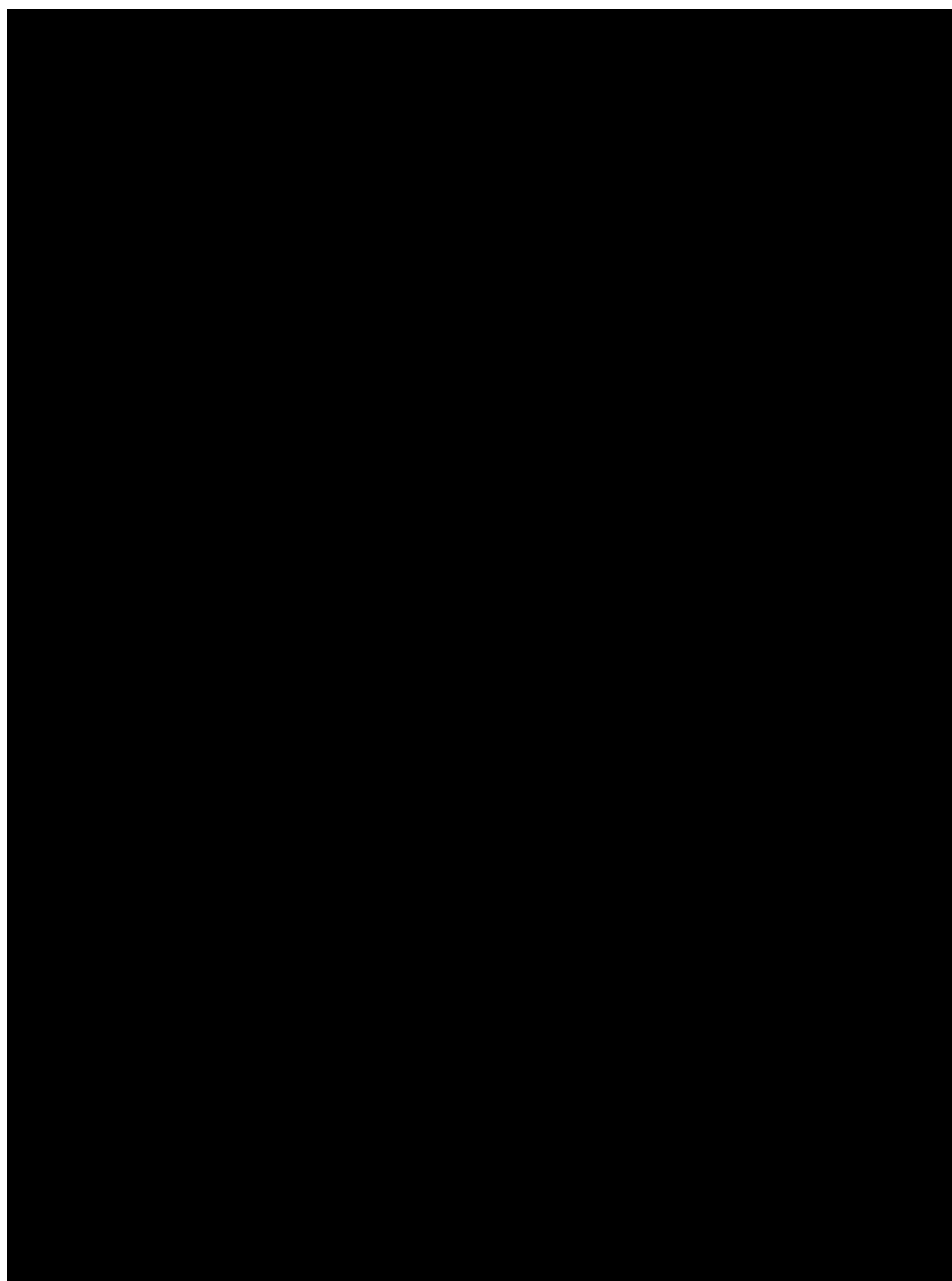
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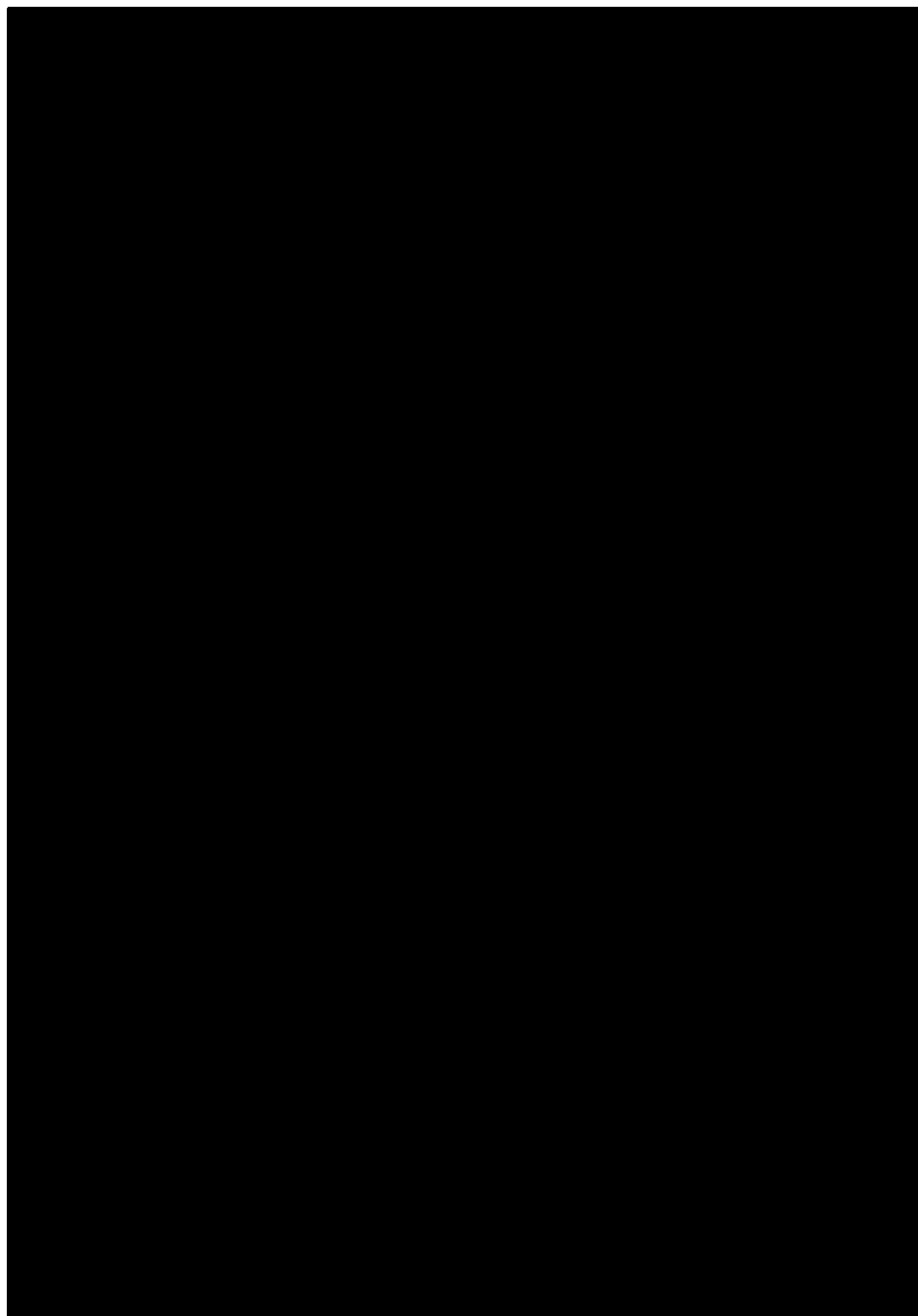
the 1990s, the number of people in the United States who are 65 years of age or older has increased by 50 percent, and the number of people 75 years of age or older has increased by 100 percent. The number of people 85 years of age or older has increased by 200 percent. The number of people 95 years of age or older has increased by 400 percent. The number of people 100 years of age or older has increased by 1,000 percent. The number of people 105 years of age or older has increased by 2,000 percent. The number of people 110 years of age or older has increased by 4,000 percent. The number of people 115 years of age or older has increased by 8,000 percent. The number of people 120 years of age or older has increased by 16,000 percent. The number of people 125 years of age or older has increased by 32,000 percent. The number of people 130 years of age or older has increased by 64,000 percent. The number of people 135 years of age or older has increased by 128,000 percent. The number of people 140 years of age or older has increased by 256,000 percent. The number of people 145 years of age or older has increased by 512,000 percent. The number of people 150 years of age or older has increased by 1,024,000 percent. The number of people 155 years of age or older has increased by 2,048,000 percent. The number of people 160 years of age or older has increased by 4,096,000 percent. The number of people 165 years of age or older has increased by 8,192,000 percent. The number of people 170 years of age or older has increased by 16,384,000 percent. The number of people 175 years of age or older has increased by 32,768,000 percent. The number of people 180 years of age or older has increased by 65,536,000 percent. The number of people 185 years of age or older has increased by 131,072,000 percent. The number of people 190 years of age or older has increased by 262,144,000 percent. The number of people 195 years of age or older has increased by 524,288,000 percent. The number of people 200 years of age or older has increased by 1,048,576,000 percent. The number of people 205 years of age or older has increased by 2,097,152,000 percent. The number of people 210 years of age or older has increased by 4,194,304,000 percent. The number of people 215 years of age or older has increased by 8,388,608,000 percent. The number of people 220 years of age or older has increased by 16,777,216,000 percent. The number of people 225 years of age or older has increased by 33,554,432,000 percent. The number of people 230 years of age or older has increased by 67,108,864,000 percent. The number of people 235 years of age or older has increased by 134,217,728,000 percent. The number of people 240 years of age or older has increased by 268,435,456,000 percent. The number of people 245 years of age or older has increased by 536,870,912,000 percent. The number of people 250 years of age or older has increased by 1,073,741,824,000 percent. The number of people 255 years of age or older has increased by 2,147,483,648,000 percent. The number of people 260 years of age or older has increased by 4,294,967,296,000 percent. The number of people 265 years of age or older has increased by 8,589,934,592,000 percent. The number of people 270 years of age or older has increased by 17,179,869,184,000 percent. The number of people 275 years of age or older has increased by 34,359,738,368,000 percent. The number of people 280 years of age or older has increased by 68,719,476,736,000 percent. The number of people 285 years of age or older has increased by 137,438,953,472,000 percent. The number of people 290 years of age or older has increased by 274,877,906,944,000 percent. The number of people 295 years of age or older has increased by 549,755,813,888,000 percent. The number of people 300 years of age or older has increased by 1,099,511,627,776,000 percent. The number of people 305 years of age or older has increased by 2,199,023,255,552,000 percent. The number of people 310 years of age or older has increased by 4,398,046,511,104,000 percent. The number of people 315 years of age or older has increased by 8,796,093,022,208,000 percent. The number of people 320 years of age or older has increased by 17,592,186,044,416,000 percent. The number of people 325 years of age or older has increased by 35,184,372,088,832,000 percent. The number of people 330 years of age or older has increased by 70,368,744,177,664,000 percent. The number of people 335 years of age or older has increased by 140,737,488,355,328,000 percent. The number of people 340 years of age or older has increased by 281,474,976,710,656,000 percent. The number of people 345 years of age or older has increased by 562,949,953,421,312,000 percent. The number of people 350 years of age or older has increased by 1,125,899,906,842,624,000 percent. The number of people 355 years of age or older has increased by 2,251,799,813,685,248,000 percent. The number of people 360 years of age or older has increased by 4,503,599,627,370,496,000 percent. The number of people 365 years of age or older has increased by 9,007,199,254,740,992,000 percent. The number of people 370 years of age or older has increased by 18,014,398,509,481,984,000 percent. The number of people 375 years of age or older has increased by 36,028,797,018,963,968,000 percent. The number of people 380 years of age or older has increased by 72,057,594,037,927,936,000 percent. The number of people 385 years of age or older has increased by 144,115,188,075,855,872,000 percent. The number of people 390 years of age or older has increased by 288,230,376,151,711,744,000 percent. The number of people 395 years of age or older has increased by 576,460,752,303,423,488,000 percent. The number of people 400 years of age or older has increased by 1,152,921,504,606,846,976,000 percent. The number of people 405 years of age or older has increased by 2,305,843,009,213,693,952,000 percent. The number of people 410 years of age or older has increased by 4,611,686,018,427,387,904,000 percent. The number of people 415 years of age or older has increased by 9,223,372,036,854,775,808,000 percent. The number of people 420 years of age or older has increased by 18,446,744,073,709,551,616,000 percent. The number of people 425 years of age or older has increased by 36,893,488,147,419,103,232,000 percent. The number of people 430 years of age or older has increased by 73,786,976,294,838,206,464,000 percent. The number of people 435 years of age or older has increased by 147,573,952,589,676,412,928,000 percent. The number of people 440 years of age or older has increased by 295,147,905,179,352,825,856,000 percent. The number of people 445 years of age or older has increased by 590,295,810,358,705,651,712,000 percent. The number of people 450 years of age or older has increased by 1,180,591,620,717,411,303,424,000 percent. The number of people 455 years of age or older has increased by 2,361,183,241,434,822,606,848,000 percent. The number of people 460 years of age or older has increased by 4,722,366,482,869,645,213,696,000 percent. The number of people 465 years of age or older has increased by 9,444,732,965,739,290,427,392,000 percent. The number of people 470 years of age or older has increased by 18,889,465,931,478,580,854,784,000 percent. The number of people 475 years of age or older has increased by 37,778,931,862,957,161,709,568,000 percent. The number of people 480 years of age or older has increased by 75,557,863,725,914,323,419,136,000 percent. The number of people 485 years of age or older has increased by 151,115,727,451,828,646,838,272,000 percent. The number of people 490 years of age or older has increased by 302,231,454,903,657,293,676,544,000 percent. The number of people 495 years of age or older has increased by 604,462,909,807,314,587,353,088,000 percent. The number of people 500 years of age or older has increased by 1,208,925,819,614,629,174,706,176,000 percent. The number of people 505 years of age or older has increased by 2,417,851,639,229,258,349,412,352,000 percent. The number of people 510 years of age or older has increased by 4,835,703,278,458,516,698,824,704,000 percent. The number of people 515 years of age or older has increased by 9,671,406,556,917,033,397,649,408,000 percent. The number of people 520 years of age or older has increased by 19,342,813,113,834,066,795,298,816,000 percent. The number of people 525 years of age or older has increased by 38,685,626,227,668,133,590,597,632,000 percent. The number of people 530 years of age or older has increased by 77,371,252,455,336,267,181,195,264,000 percent. The number of people 535 years of age or older has increased by 154,742,504,910,672,534,362,390,528,000 percent. The number of people 540 years of age or older has increased by 309,485,009,821,345,068,724,781,056,000 percent. The number of people 545 years of age or older has increased by 618,970,019,642,690,137,449,562,112,000 percent. The number of people 550 years of age or older has increased by 1,237,940,039,285,380,274,899,124,224,000 percent. The number of people 555 years of age or older has increased by 2,475,880,078,570,760,549,798,248,448,000 percent. The number of people 560 years of age or older has increased by 4,951,760,157,141,521,099,596,496,896,000 percent. The number of people 565 years of age or older has increased by 9,903,520,314,283,042,199,193,993,792,000 percent. The number of people 570 years of age or older has increased by 19,807,040,628,566,084,398,387,98

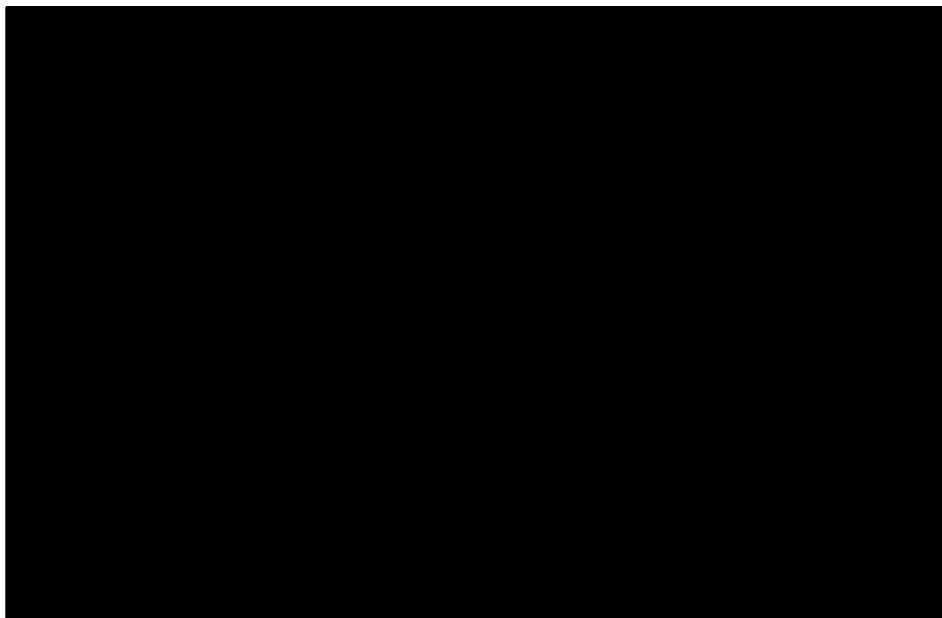


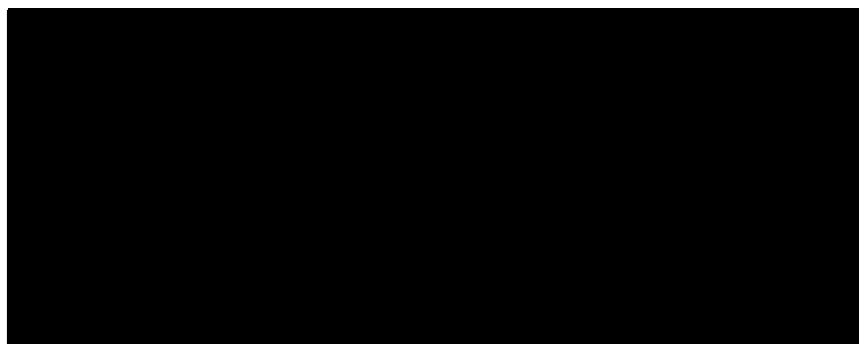
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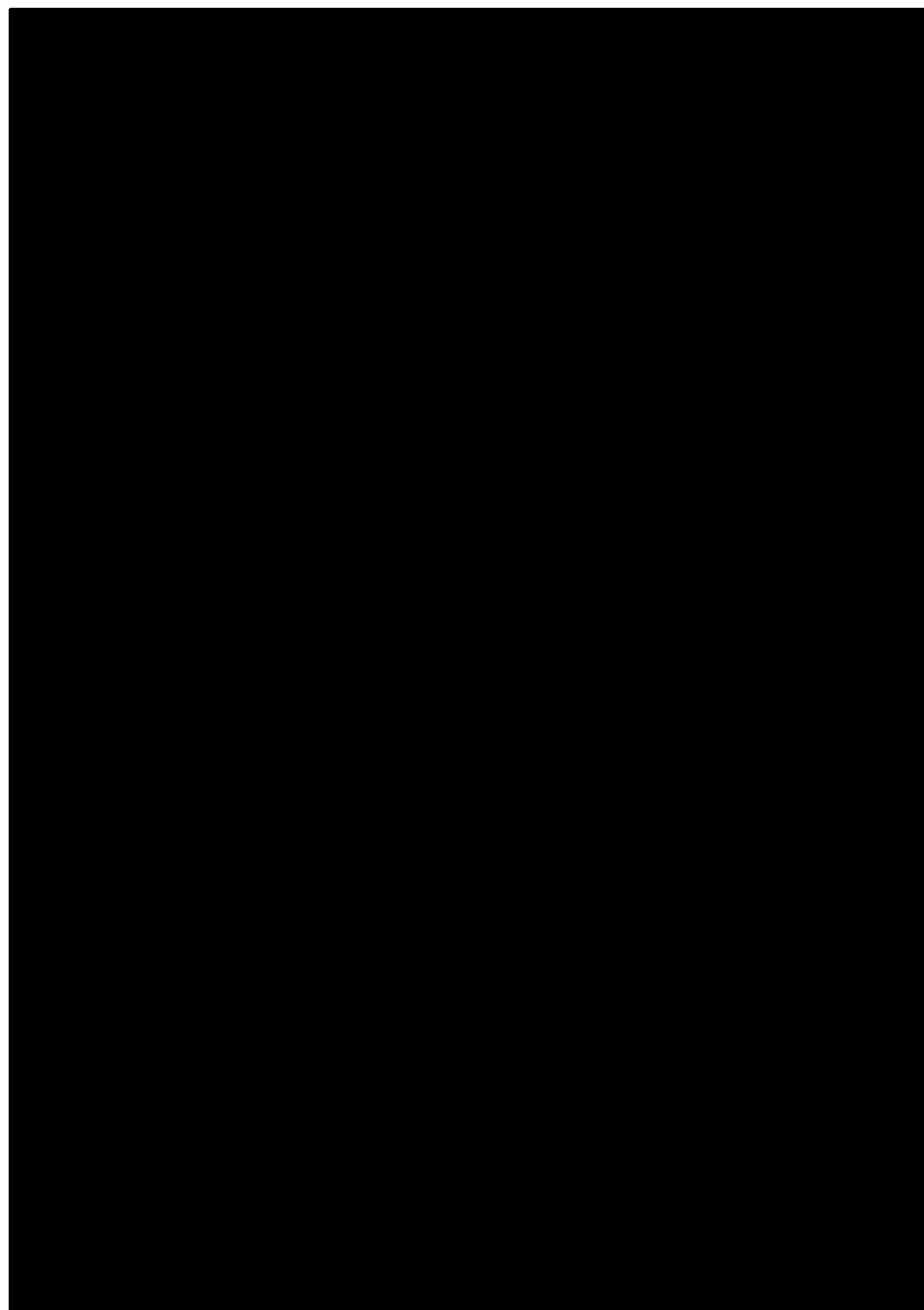


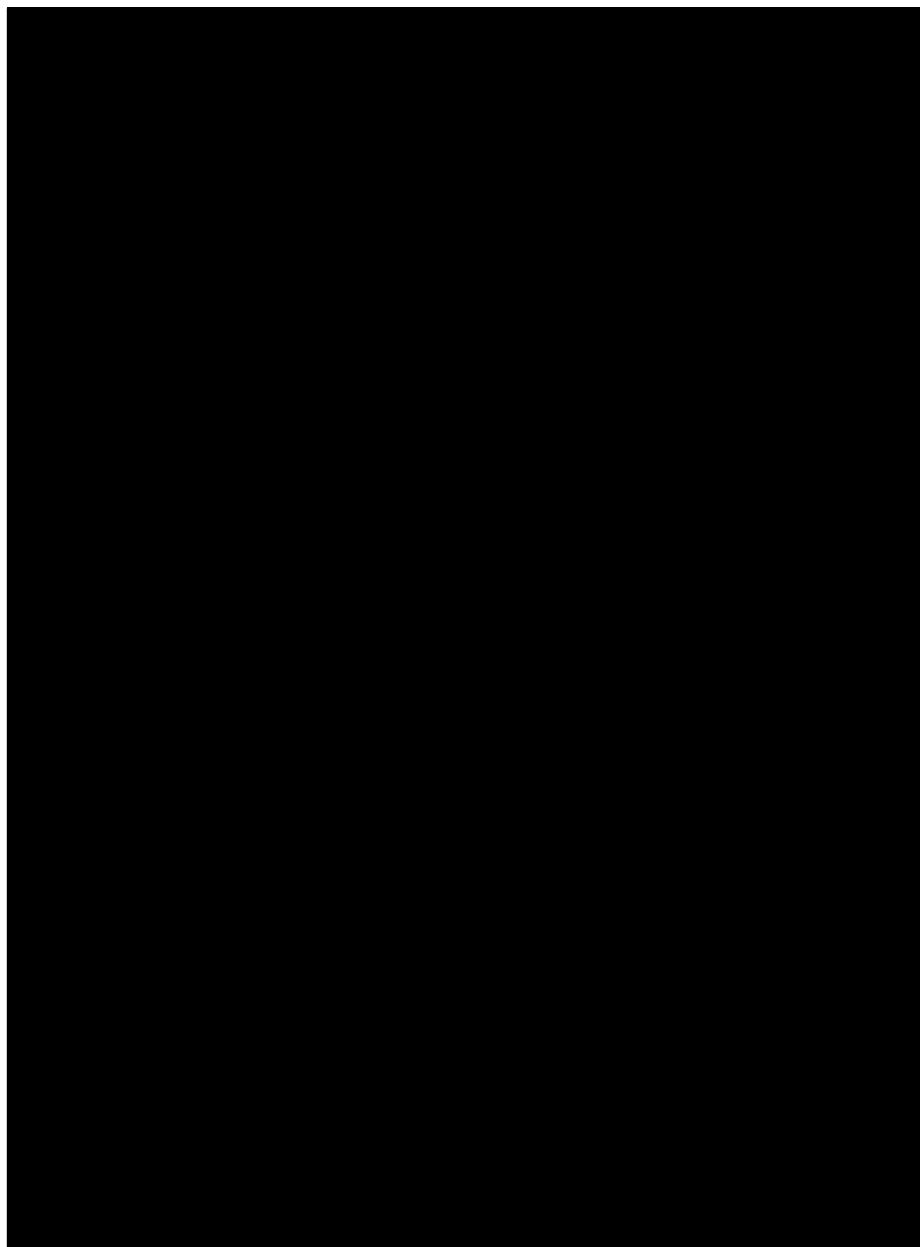












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